

Research Experience Placement (REP) Scheme 2026

Supervisor Project Proforma

Project title:	Ploidy plasticity in fungus <i>Candida parapsilosis</i> drives cross-kingdom infections.
Host Institution:	University of Birmingham
Project supervisor (name, department):	Hung-Ji Tsai, School of Biosciences
Project enquiries (supervisor email):	h.tsai@bham.ac.uk
Co-Supervisor, if any (name, department):	Dr Bethany Pettifor, School of Biosciences
Proposed start date and weekly hours: (please note project must be of 6 weeks duration)	15 st June 2026/35 hours
Please provide a short paragraph or couple of sentences summarising the project to encourage potential applicants to apply (max 75 words):	
<p>Fungal diseases have emerged as a global threat, causing species extinction, food insecurity, and clinical burden. How environmental fungi acquire the capacity to invade diverse niches remains unclear. Our recent discoveries of extensive ploidy variation in the environmental fungus <i>Candida parapsilosis</i> across different ecosystems have now motivated us to investigate the relationship between ploidy dynamics and pathogenic potential, leading to cross-kingdom infections. We will combine experimental evolution and molecular approaches to elucidate this adaptive process.</p>	
Project description (max 700 words, 1-2 figures may be included):	
<p>Proposed projects must:</p> <ul style="list-style-type: none"> • Have a clearly defined objective • Be within the science remit of NERC • Be feasible for a student to complete within the timescale of the placement • Include more than purely a computer/modelling component i.e., some element of fieldwork, data collection, activity to give an understanding of the wider context including participation in lab/team meetings, networking, and training etc. • Give scope for thought and initiative on the part of the student and should not use the student as a general assistant • Be based at an eligible UK research organisation (remote placements from within the UK are also an option for enabling inclusivity) 	
<p>Environmental fungus <i>Candida parapsilosis</i> lives across diverse ecological niches including soils, plants, animals, and humans. While its intrinsic pathogenic potential in natural environment remains unclear, <i>C. parapsilosis</i> is part of the environmental microbiota and can be isolated from rhizosphere in a collection of ~20,000 wild microbial isolates across the UK (J. McDonald lab, UoB). Despite being an unlikely pathogen, rather than absolute</p>	

pathogen, *C. parapsilosis* has arisen as one of the top three causes of fungal bloodstream infections in the recent years in the UK, originated from the environmental reservoirs.

Interestingly, we have discovered that these isolates harbour a wide range of ploidy variations (haploid, aneuploid, and tetraploid) although *C. parapsilosis* is considered a diploid species. As environmental fungi can leverage genome plasticity to adapt to diverse natural niches, this motivates us to ask whether such ploidy variation arises intrinsically in the environment or is driven by host-associated adaptation, that enables pathogenic transition. Importantly, while the transmission of *C. parapsilosis* is mainly through direct contact, we will further assess the impacts of ploidy dynamics in cross-kingdom infections, including plants and insects. Together, this project aims to decipher the connections between fungal genomic dynamics and its role in ecological health.



Figure 1. Wild-type (left, lab strain) and haploid (right, clinical isolate) *C. parapsilosis* were inoculated and colonised (white arrows) to oak leaves in microcosm system.

In our preliminary observations, we found that haploid *C. parapsilosis* isolates from the clinical environment can colonize leaves with substantial higher survival (Figure.1). While *C. parapsilosis* primarily transmitted via direct contacts (e.g., hands), we aim to establish the bi-directional cross-kingdom infection models in this project. To address this, we propose two parallel research directions.

Direction-1: Assessing genomic and phenotypic changes in response to plant colonization.

While *C. parapsilosis* is considered a commensal organism, whether ploidy shifts, commonly observed in wild yeasts, are critical for colonisation remains unknown. We will infect plants (leaves, stems, and roots) with wild-type *C. parapsilosis* using a microcosm system. Colonies (up to 90) will be isolated and stored immediately for downstream analyses.

All isolates will be assessed for ploidy levels using flow cytometry. In parallel, their growth will be assessed under a range of host-relevant stresses, including oxidative stress, antifungal exposure, osmotic stress, temperature fluctuations, and nutrient limitation. Selected isolates showing ploidy shifts will be further karyotyped using qPCR. Together, these experiments will determine whether plant-associated stresses drive ploidy dynamics and promote phenotypic variation that may facilitate adaptation or pathogenicity in plant hosts.

Direction-2: Examining cross-kingdom adaptation in plant-adapted *C. parapsilosis*.

Cross-kingdom infection is an emerging threat across ecosystems, yet its link with genomic variation (e.g., aneuploidy) remains poorly understood. To address this, we will use both plant (oak or *Arabidopsis*) and invertebrate animal (*Galleria mellonella*) models.

Plant-adapted isolates (from Direction-1) and clinical isolates (haploid, diploid, and tetraploid; manuscript in preparation) will be used to infect animal and plant hosts, respectively. Fungi recovered from infected hosts will then be inoculated to the other host (planted-adapted fungi to animal; animal-adapted fungi to plant) to assess changes in virulence considering cross-kingdom infections. At each passage, ploidy dynamics and phenotypic traits will be systematically characterised.

Together, this work will establish a novel link between ploidy dynamics and cross-kingdom adaptation. While fungal diseases impact multiple ecosystems, this project focuses on how environmental adaptation shapes pathogenic potential. This aligns with the scientific remit of NERC, particularly in understanding ecosystem interactions. Importantly, this research explores an understudied area, building on our expertise in fungal genome plasticity.

Project timeline:

Week	1	2	3	4	5	6
Strain collection and experimental setup						
Ploidy analyses						
Phenotypic assessment						
Plant and animal infections						

Candidate requirements:

Basic microbiology and molecular biology techniques.

Background reading and references:

1. Guinea, J., Escribano, P., Cadeau, M. *et al.* Emerging antifungal resistance in *Candida parapsilosis*: the end of the innocence. *npj Antimicrob Resist* **3**, 99 (2025). <https://doi.org/10.1038/s44259-025-00173-5>
2. Berman, J., Ploidy plasticity: a rapid and reversible strategy for adaptation to stress, *FEMS Yeast Research*, Volume 16, Issue 3, May 2016, fow020, <https://doi.org/10.1093/femsyr/fow020>

To be completed by institutional CENTA PoC

I confirm that:

- The host institution takes responsibility for selecting a suitable undergraduate student and ensuring and confirming their eligibility under the NERC REP student eligibility criteria.
- This REP project falls within the NERC remit, is of suitable quality and meets the REP research project criteria.
- Appropriate supervisory arrangements are in place.
- The application processes used will be inclusive and accessible.



- Reasonable adjustments will be made for students that need them whilst undertaking placements.
- The placement will be carried out in accordance with all applicable ethical, legal and regulatory requirements including but not limited to relevant provisions of the General Data Protection Regulation, the Data Protection Act 2018, the Bribery Act 2010, the Fraud Act 2006, the Equality Act 2010 and the Modern Slavery Act 2015.
- The host organisation takes responsibility for identification, protection and exploitation of any intellectual property rights arising from the work.
- All facilities, agreements about access and collaborations necessary for the work will be obtained before the work commences and can be ensured through the period of the work.
- All costs awarded by NERC for the REPs will be used and accounted for appropriately.
- A report of the project by the student will be submitted no later than one week after the end date of the placement or Friday 25th September 2026, whichever falls first.
- A PhD interview (where possible) will be offered to all students who have completed a REP within the CENTA Doctoral Landscape Award.

Signed: Tom Matthews

Date: 13/4/2026

Position: PoC